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Male androphilia, fraternal birth order, and female fecundity in Samoa: A 10-y retrospective

Scott W. Semenyna[a,1], Francisco R. Gómez Jiménez[b], Doug P. VanderLaan[c], and Paul L. Vasey[d]

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Two separate but related literatures have examined familial correlates of male androphilia (i.e., sexual attraction and arousal to masculine adult males). The fraternal birth order effect (FBOE) is a widely established finding that each biological older brother a male has increased the probability of androphilia 20–35% above baseline rates. Other family demographic variables, such as reproduction by mothers, maternal aunts, and grandmothers, have been used to test evolutionary hypotheses that sexually antagonistic genes lead to androphilia among males, lowering or eliminating reproduction, which is offset by greater reproductive output among their female relatives. These proposed female fecundity effects (FFEs), and the FBOE, have historically been treated as separate yet complementary ways to understand the development and evolution of male androphilia. However, this approach ignores a vital confound within the data. The high overall reproductive output indicative of an FFE results in similar statistical patterns as the FBOE, wherein women with high reproductive output subsequently produce later-born androphilic sons. Thus, examination of the FBOE requires analytic approaches capable of controlling for the FFE, and vice-versa. Here, we present data simultaneously examining the FBOE and FFE for male androphilia in a large dataset collected in Samoa across 10 y of fieldwork, which only shows evidence of the FBOE.

male androphilia | cross-cultural research | sexual orientation | balancing selection | sexually antagonistic selection

The biodevelopmental foundations of male androphilia (i.e., sexual arousal and attraction to masculine adult males) are not completely understood, although data have been reported that are consistent with genetic, hormonal, and (non-social) environmental influences on the trait (1–4). The most widely replicated biodemographic correlate of male androphilia is the fraternal birth-order effect (FBOE)—the finding that each additional biological older brother a male has increases the likelihood that he will be exclusively androphilic (5). The FBOE has a plausible candidate mechanism as explicated by the maternal immune hypothesis (MIH), which posits that a mother's progressive exposure to male antigens via gestation of male fetuses elevates her immune responses, which in turn impede in-utero brain masculinization of subsequent male fetuses [e.g., (6)]. Recent studies have also documented a sororal birth order effect (SBOE), with a relationship between number of older sisters and the likelihood of male androphilia (7, 8). The SBOE does not presently have a candidate mechanism of action [e.g., (9)], and it is unclear whether it represents a unique influence on male androphilia or is instead a by-product of the correlation between number of older sisters and older brothers (8, 10).

The FBOE is a well-established proximate developmental pathway to male androphilia that is often considered separately from ultimate explanations for the existence and maintenance of male androphilia at the population level, such as female fecundity effects (FFEs). FFEs are leading ultimate hypotheses to explain the persistence of male androphilia, positing that the lower reproduction of androphilic males [e.g., (11–15)] is offset by female relatives reproducing at elevated rates [e.g., (16–20)]. One example of an FFE model would be mothers of androphilic males reproducing significantly more than mothers of men who are gynephilic (i.e., sexually attracted to and aroused by feminine adult females), which invokes balancing selection to help resolve the evolutionary paradox of male androphilia (11, 21).

Both the FBOE and FFE have empirical support, but an often unacknowledged confound exists among the datasets used to examine both patterns. The FFE can be inferred by comparing mean sibship size of androphilic and gynephilic males, whereas studies of the FBOE consider sibship size and composition. Because overall sibship size correlates with the number of older brothers, it is possible that the appearance of an FFE is simply a statistical artifact of the FBOE (7, 22). This means that women who have a large number of children for any reason (culture, religion, etc.) are more likely to have later-born androphilic sons with a preponderance of older brothers. An FFE would mean that women who bear androphilic sons have higher reproductive output that affects all sibling

Significance

We compile 10 y of data from fieldwork in Samoa, a high fertility non-Western population, relevant to both evolutionary and biodevelopmental hypotheses for male androphilia (sexual attraction to adult males). One hypothesis is that mothers carry genes that increase their own reproduction but lead to androphilia when passed on to sons. Another hypothesis is that maternal immune response to the gestation of successive male fetuses feminizes psychosexual brain development in later-born males. The same family data can address reproductive and fraternal birth order effects (FBOE), but analysis must disentangle each. We find no evidence of a generalized pattern of elevated reproduction among mothers of androphilic males once controlling for the FBOE on male sexual orientation.

Author affiliations: [a]Department of Psychology, Stetson University, DeLand, FL 32723; [b]Centre for Culture and Evolution, Department of Life Sciences, Brunel University London, London UB8 3PH, United Kingdom; [c]Department of Psychology, University of Toronto, Mississauga, ON L5L 1C6, Canada; and [d]Department of Neuroscience, University of Lethbridge, Lethbridge, AB T1K 3M4, Canada

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[1]To whom correspondence may be addressed. Email: ssemenyna@stetson.edu.

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categories in relation to their androphilic sons (i.e., older brothers, younger brothers, older sisters, and younger sisters). Alternatively, if only the FBOE is present, a woman with high reproductive output will be more likely to produce androphilic sons with an abundance of one sibling category, older brothers (FBOE). If only the latter were true, it would represent a type of sample selection bias in studies of the FFE, confusing the more specific FBOE for a general FFE. Most studies treat the FBOE and FFE as separate empirical phenomena, but this approach is almost certainly incorrect (7, 10, 22). Here, we present data simultaneously examining both effects in a large dataset collected in Samoa across 10 y of fieldwork.

In Samoa, most androphilic males are known locally as *fa'afafine* (23), a "third" gender category that is distinct from men and women. *Fa'afafine* largely express themselves in an effeminate manner, almost always report exclusive androphilia, and enjoy substantial acceptance in Samoan culture. Male androphiles, such as Euro-American gay men and Samoan *fa'afafine,* share numerous biodemographic and personality correlates, including the FBOE (24), clustering in families (25), heightened childhood separation anxiety from major caregivers (26), greater childhood sex-atypical behaviors, and greater interest in female-typical occupations in adulthood (27). Importantly, *fa'afafine* comprise ~2–5% of the male population of Samoa (25), which is consistent with prevalence estimates of male androphilia in Euro-American cultures (1) and throughout other parts of the globe (28, 29). This evidence suggests that male androphilia is expressed differently depending on the cultural context in which it develops (see also ref. 23). This means that understanding the biodevelopmental foundations of androphilic males in Samoa (i.e., *fa'afafine*) likewise informs our understanding of male androphilia in Euro-American cultures, which is typically expressed in more masculine fashion (i.e., "gay" men).

The FBOE has been found in three separate, but partially overlapping Samoan samples, indicating that *fa'afafine* have a greater number of older brothers than do Samoan gynephilic men (24, 30, 31). Additional studies have also found FFEs in Samoa, including elevated reproduction among the mothers of *fa'afafine* relative to those of gynephilic men (32, 33). As noted above, these comparisons are vulnerable to the same confound as other studies on these topics, creating uncertainty as to whether both the FBOE and FFE are present, or simply one of these effects. As such, the present study utilizes statistical advances in this area capable of extricating the FBOE and FFE in the same data (7, 22).

A recent population-level study utilizing Dutch registry data found evidence for the presence of the FBOE, but no evidence of an FFE, related to male androphilia (7). However, the Dutch data may have been susceptible to stopping rules, wherein family preferences for children of one sex, or one child of each sex, lower estimates of both the FBOE and FFE [(34), but see ref. 35]. Additionally, the Netherlands has seen family demographic shifts in the past 50 y toward reduced overall family size (7), much like other Euro-American nations (36). Such samples are not ideal for testing evolutionary hypotheses pertaining to male androphilia. Conversely, Samoa offers a powerful test case for examining the FBOE and FFE for male androphilia given that the mean reproductive output of women remains closer to natural fertility and women showing no obvious signs of stopping rules for a certain number or sex ratio of children (36).

Present Study

Rather than making specific predictions, we outline what various patterns would reveal about the viability of the FBOE and FFE, and the hypotheses that inspire such analysis. Simultaneously examining both the FBOE and FFE allows us to discern whether one or both findings are genuine. If the FBOE is found, while controlling for FFE, then this will add to an existing body of empirical research documenting this correlate of male androphilia and call for an explanation such as the MIH. If the FFE is found, while controlling for the FBOE, then this would add to other research suggesting that elevated reproductive output allows females to offset reduced reproduction by their androphilic male kin. Given that both the FBOE and FFE have been documented in Samoa, the present data will not show an absence of either effect when examined in isolation, but it remains to be seen whether both effects will persist when data are appropriately analyzed. Results will inform future work aiming to understand the proximate and ultimate mechanisms underlying male androphilia.

Materials and Methods

Participants. Archival data spanning field trips from 2004 to 2013 were used for the present analyses. All data were collected with Institutional Review Board approval from the University of Lethbridge, and appropriate research permits were obtained from the Samoan government. Participants were informed that their responses were entirely confidential and required to sign a statement indicating informed consent before participating. A network sampling procedure was employed such that initial participants (i.e., *fa'afafine* or men) were contacted, with participants providing additional referrals. As previously noted, portions of the present data have been examined in other studies (5, 24, 30–33), although the present sample supersedes all previous reports which are necessarily subsets of the full dataset. Original questionnaire data were consulted and coded by the first two authors.

A total of 1,321 questionnaires were eligible for coding, including 813 gynephilic men and 508 *fa'afafine*. Participants' sibship characteristics were cross-referenced with their date of birth (DOB) to identify duplicates, erring on the side of exclusion for potential duplicates and ensure independence of data. Priority was given to retaining the newer biodemographic information when excluding duplicates for existing participants to allow for the possibility of additional younger siblings between collection years. Full exclusion criteria are explained in *SI Appendix*. We removed 110 gynephilic men, and 150 *fa'afafine* from the initially coded data, resulting in a final sample (N = 1,061) composed of 703 unique gynephilic men and 358 unique *fa'afafine*.

Measures. Participants were interviewed using standardized questionnaires that were translated and back-translated by two Samoan-speaking research assistants. A Samoan research assistant was present during data collection to provide instructions to all participants and to answer questions. The questionnaire asked participants to report their age (DOB), gender-identity (i.e., *fa'afafine* or man), and sibship composition. Sexual orientation was measured using a 7-point Kinsey-style scale (37) evaluating sexual attractions/fantasy over the past year ranging from exclusive attraction to women (i.e., gynephilia, scored 0) to exclusive sexual attraction to men (i.e., androphilia, scored 6). Participants reported detailed information about their number of biological siblings, sibling sex (i.e., male siblings who identify as men or *fa'afafine* were both counted as brothers in our analysis), as well as the order of all sibling births. Participants could answer these family demographic questions alone, but it was not unusual for them to also receive assistance from nearby relatives. Birth order information was used to tabulate several data points for each participant, including number of older brothers, older sisters, younger brothers, and younger sisters, as well as number of older, younger, and total siblings.

Analysis Plan. All calculations were performed using JASP version 0.18 (38). When relevant, we report 99.5% CIs (39). Data were first analyzed in a manner consistent with past examinations of the FBOE and FFE to establish these potential effects as traditionally defined. Next, we reexamine the data according to the recent analytic advancements proposed by Ablaza et al. (7), before adding our own additional analyses that further probe the existence of an FFE in the Samoan data. Data for the final sample, with duplicates, exclusions, and identifying information removed, as well as an analysis files, are available on the Open Science Framework (40) (https://osf.io/pmdeg/).

Table. 1. Sibship characteristics of *fa'afafine* and gynephilic men

	Fa'afafine (*n* = 358)	Gynephilic men (*n* = 703)	Two-tailed *t* test			
	M (*SD*)	*M* (*SD*)	*t*-statistic	*df*	*P*	Cohen's *d*
Older brothers	1.88 (1.76)	1.24 (1.35)	6.06	576.0*	<0.001	0.41
Older sisters	1.74 (1.60)	1.17 (1.25)	5.91	582.1*	<0.001	0.40
Younger brothers	1.02 (1.23)	1.12 (1.24)	−1.26	1,059	0.206	−0.08
Younger sisters	1.00 (1.22)	1.13 (1.16)	−1.71	1,059	0.088	−0.11
Total siblings	5.65 (2.92)	4.66 (2.26)	5.57	579.6*	<0.001	0.38

*Degrees of freedom adjusted due to a significant Brown–Forsythe test ($P < 0.05$), with Welch's *t* test reported.

Results

Among the final sample, most of the men ($n = 684$) reported exclusive gynephilia (i.e., Kinsey 0), with 19 individuals reporting predominant gynephilia but an occasional fantasy about males (Kinsey 1). All *fa'afafine* reported either exclusive androphilia (Kinsey 6; 352), or near exclusive androphilia (Kinsey 5; six participants). Average age at interview was similar for gynephilic men ($M_{age} = 30.45$, $SD = 10.18$) and *fa'afafine* ($M_{age} = 29.65$, $SD = 9.57$), $t_{(1059)} = 1.23$, $P = 0.218$, $d = 0.08$. Participants had a mean of 4.99 siblings ($SD = 2.54$), meaning that stopping rules were unlikely to influence patterns in the present data (41). Statistical evidence ruling out stopping rules is provided in *SI Appendix*. Full sibship characteristics are reported in Table 1, with *fa'afafine* reporting significantly higher numbers of older brothers, older sisters, and total siblings.

The patterns noted in Table 1 would generally be interpreted as consistent with an FBOE and FFE, given *fa'afafine's* significantly greater number of older brothers, older sisters, and overall siblings, respectively. However, the FBOE has typically been quantified with the use of binary logistic regressions capable of isolating the influence of older brothers on the likelihood of male androphilia, and precisely quantifying the proportional increase in odds associated with each older brother (42). Table 2 reports these analyses. In model 1, we regressed sexual orientation group on older brothers, older sisters, younger brothers, and younger sisters. Results showed the presence of both the FBOE and a SBOE in the traditional model (Model 1), $\chi^2 = 57.86$, $df = 1{,}056$, $P < 0.001$. Some past analyses have specifically sought to isolate the influence of older brothers while controlling for family size [e.g., (30, 43)], so Model 2 regressed sexual orientation on older brothers and all other siblings combined. This too showed the presence of the FBOE, $\chi^2 = 47.62$, $df = 1{,}058$, $P < 0.001$. In the past, we may have attributed the influence of "Other Siblings" on the probability of male androphilia to the presence of the FFE, but recent analytic improvements (see below) indicate that this conclusion would be premature. Alternative metrics for quantifying the FBOE using simple descriptive statistics have also been proposed, including the older brother odds ratio and the older sister odds ratio (44). These metrics, which also demonstrate the existence of an FBOE and SBOE, are reported in *SI Appendix*.

The data so far clearly support the FBOE and suggest an FFE. Khovanova (22) examined the ways in which these effects are mathematically confounded, proposing a novel approach to tease apart the presence of the FBOE and FFE (see also ref. 21). One analytic approach is to constrain the data to families with one or two sons* and no daughters, thus controlling for family size. Such an approach drastically reduces the available data points (30 men, 7 *fa'afafine*), so it was not undertaken. [A second approach proposed by Khovanova (22) showed equivocal support for the FBOE and FFE and is reported in *SI Appendix*.] To avoid restrictive analytic criteria that reduce overall sample size (22), and simultaneously examine the FBOE (or SBOE) and FFE, Ablaza et al. (7) employed a novel method that allows for full samples to be retained, with slight modifications to the binary logistic parameters reported in Table 2.

We used two parameterizations proposed by Ablaza et al. (7), and redescribed by Blanchard (34), allowing us to precisely estimate the FBOE and SBOE in our sample, as well as detect a potential FFE. Both models predict the likelihood of being a *fa'afafine* based on total siblings, number of older siblings, and either the number of older sisters (Model 3, testing the FBOE) or the number of older brothers (Model 4, testing the SBOE). Both models test the FFE by examining the likelihood that an excess number of total siblings predicts sexual orientation while controlling for the FBOE (or SBOE). Model 3 examines the FBOE while controlling for total siblings (FFE) and number of older sisters. Model 4 similarly examines the SBOE while controlling for total siblings (FFE) and number of older brothers. Table 3 reports the results of two binary logistic regression models. As expected, both models produce identical omnibus test statistics ($\chi^2 = 57.79$, $df = 1{,}057$, $P < 0.001$, Nagelkerke $R^2 = 0.073$). Model 3 indicates the presence of the FBOE, and Model 4 indicates the presence of the SBOE, whereas the FFE is absent ($P = 0.949$).

To complement the analysis above, we further examined fecundity effects among various subsets of our final sample by constraining analysis to include participants with varying numbers of older siblings (Table 4). As reported above and repeated in Table 4, *fa'afafine* reported significantly more siblings than Samoan gynephilic men among the full sample, indicating that their mothers may have displayed an FFE. Previous studies of the FFE have examined sibship size among first-born males (16), and we do the same here. When we isolated a subsample of *fa'afafine* and gynephilic men with no older siblings, presumably eliminating any FBOE, no difference in sibship size was found. Similarly, nonsignificant differences were found when examining participants who had no older brothers (allowing for older sisters), and among those with no older sisters (allowing for older brothers), and this pattern held when expanding the sample in a progressive fashion to include those with one, two, or three older siblings. Indeed, highly significant differences between *fa'afafine* and gynephilic men's total sibling number only emerged when considering participants with up to three older brothers, or up to seven older siblings, indicating that the overall group difference in the total sample is being driven by a small number of *fa'afafine* from markedly large families. To further illustrate this, *fa'afafine* are disproportionately likely to have eight or more older siblings (9.78%)

*Here we use son to denote a male offspring, a designation that would be accepted by Samoans generally, and *Fa'afafine* more specifically.

Table. 2. Traditional logistic regressions to detect the FBOE

Model	Nagelkerke R^2	Predictor	(*B*)	*SE*	*p*	*OR* (99.5% CI)
1	0.074	Older brothers	0.207	0.048	<0.001	1.23 (1.07, 1.41)
		Older sisters	0.211	0.052	<0.001	1.23 (1.07, 1.43)
		Younger brothers	0.041	0.058	0.478	1.04 (0.89, 1.23)
		Younger sisters	0.017	0.061	0.776	1.02 (0.86, 1.21)
2	0.061	Older brothers	0.271	0.043	<0.001	1.31 (1.16, 1.48)
		Other siblings	0.084	0.032	0.009	1.09 (0.99, 1.19)

Note: All models tested with simultaneous entry of all variables. Gynephilic men coded as 0, *fa'afafine* as 1.

compared with Samoan men (2.42%), a statistically significant difference ($\chi^2 = 27.56$, $df = 1$, $P < 0.001$). Among this subsample of 52 participants with unusually elevated sibship sizes (and late birth order), *fa'afafine* reported more total siblings ($M = 10.89$, $SD = 2.05$) compared with gynephilic men ($M = 9.71$, $SD = 1.45$), $t_{(50)} = 2.12$, $P = 0.039$, $d = 0.63$.

Discussion

The present study combined data collected during 10 y of fieldwork in Samoa to examine the FBOE on male androphilia and whether the mothers of androphilic males show a genuine FFE. Our research group has previously concluded that Samoan data evidence both the FBOE (24, 30, 31) and FFE (31, 32). We have retraced the kinds of analyses that led to these conclusions in a sample that supersedes past studies and presented additional approaches capable of disentangling the FBOE and FFE. These analyses indicate that only one of these effects is truly present—the FBOE. Put simply, elevated reproduction of *fa'afafines'* mothers appears to be an artifact of highly fecund mothers with multiple sons increasing the odds of androphilia in younger sons.

This conclusion is predicated on converging evidence from the logistic models (Table 3) proposed by Ablaza et al. (7), as well as our own analysis comparing the sibship size of individuals varying in number of older siblings (Table 4). Among participants with six or fewer older siblings, no significant differences in sibship size were found between gynephilic men and *fa'afafine*. Differences in sibship size emerged only when comparing participants with up to three older brothers, or up to seven total siblings—the very same individuals presumably most likely to experience an FBOE. Although the reason(s) for this elevated reproduction is unclear, it does not appear to be the case that mothers of *fa'afafine* exhibit elevated reproduction due to the generalized FFEs hypothesized to explain the maintenance of male androphilia at the population level. This elevated reproduction also produced an SBOE, with older sisters being independently related to the probability of androphilia (Models 1 and 4). Evidence is mounting for an SBOE of similar magnitude to the FBOE [e.g., (7, 8)], demanding some explanation. The SBOE presently has no candidate mechanism (9), although it may be related to maternal immune factors similar to the FBOE (34). Because the number of older brothers and sisters tends to be correlated (8), and modeling indicates that the SBOE emerges as a mathematical artifact when the FBOE is present (10), we do not presently interpret the SBOE as indicating that mothers carrying genes related to male androphilia reproduce at higher rates. Rather, we prefer the more cautious interpretation that the SBOE is another indication that mothers with large numbers of children are more likely to have (later born) androphilic male children.

Other research in Euro-America has previously reported elevated reproduction among mothers of androphilic males [e.g., (13, 14, 45)], and it is possible that these findings are spurious associations driven by the FBOE. This should more properly be restated to convey that these mothers have high reproduction for unknown reasons, this high reproduction increased the probability that they had androphilic sons through the FBOE, and their reproductive output was subsequently counted in samples examining the sibship size of these androphilic sons. This is not to say that all hypothesizing about FFEs should be disregarded.

One potential FFE pertaining to male androphilia is the X-chromosome linked version of the sexually antagonistic gene hypothesis, which suggests that X-linked genes passing through the maternal line result in elevated reproduction for female carriers, but androphilia among male carriers (16, 46). The key test of this hypothesis is not the reproductive output of mothers, as presently examined, but of maternal aunts (16). If maternal aunts show high reproductive output alongside mothers, it is still plausible that this fecundity is related to sexually antagonistic genes they share with their androphilic nephews. Such reproductive output is incapable of leading to a nephew's androphilia, thereby circumventing the FBOE/FFE confound among mothers of androphilic males. Only some Euro-American data indicate elevated reproduction among

Table. 3. Logistic regression parameters to detect FBOE, SBOE, and FFE

Model	Predictor	Brief Explanation	(*B*)	*SE*	*p*	*OR* (99.5% CI)
3	Total siblings	Sibship size (FFE)	0.030	0.037	0.424	1.03 (0.93, 1.14)
	Older siblings	FBOE (controlling for FFE)	0.177	0.054	0.001	1.19 (1.03, 1.39)
	Older sisters		0.005	0.080	0.949	1.01 (0.80, 1.26)
4	Total siblings	Sibship size (FFE)	0.030	0.037	0.424	1.03 (0.93, 1.14)
	Older siblings	SBOE (controlling for FFE)	0.181	0.057	0.001	1.20 (1.02, 1.41)
	Older brothers		−0.005	0.080	0.949	0.99 (0.79, 1.25)

Note: All models tested with simultaneous entry of all variables. Gynephilic men coded as 0, *fa'afafine* as 1. For full explanation of parameterization see Ablaza et al. (7) as well as Blanchard (34).

Table. 4. Comparison of total siblings among participants with varying *sibship* sizes

	Fa'afafine *M* (*SD*)	Gynephilic men *M* (*SD*)	*t*-statistic	*df*	*P*	Cohen's *d*
Total sample	5.65 (2.92)	4.66 (2.26)	5.57	579.6*	<0.001	0.38
n	358	703				
No older siblings	3.08 (2.23)	3.21 (1.86)	−0.40	198	0.687	−0.07
n	49	151				
No older brothers	3.82 (2.45)	3.78 (2.16)	0.13	343	0.894	0.02
n	87	258				
No older sisters	3.67 (2.32)	3.68 (2.04)	−0.03	361	0.979	0.00
n	100	263				
≤ 1 older sibling	3.36 (2.25)	3.58 (2.01)	−0.91	376	0.365	−0.11
n	92	286				
≤ 2 older siblings	3.75 (2.19)	3.74 (1.93)	0.05	230.9*	0.960	0.00
n	146	405				
≤ 3 older siblings	4.12 (2.18)	3.95 (1.89)	0.96	311.7*	0.335	0.08
n	195	512				
≤ 3 older brothers	4.96 (2.44)	4.41 (2.08)	3.40	512.2*	<0.001	0.24
n	303	653				
≤ 7 older siblings	5.08 (2.39)	4.54 (2.13)	3.46	569.7*	<0.001	0.24
n	323	686				

*Degrees of freedom adjusted due to a significant Brown–Forsythe test ($P < 0.05$), with Welch's *t* test reported.

androphilic males' maternal aunts (16, 45, 47, 48), whereas others show null effects (13, 14, 48). Data from outside Euro-America show similar patterns, with an FFE being found among the maternal aunts of androphilic males in the Istmo region of Oaxaca, Mexico (49), but not in Samoa (32, 33). Further, it has been suggested that an FFE may be underpinned by traits related to elevated fertility (e.g., attractiveness, symmetry), but direct tests have not supported this idea (50, 51). Thus, although the sexual antagonism hypothesis remains theoretically viable, it has been met with underwhelming empirical support.

Unlike FFEs, the FBOE is the most widely replicated biodemographic correlate of male androphilia [e.g., (5)], was recently confirmed in high-quality population level data (7), is robust to many alternative analytic approaches (10, 22, 34, 35), and has a plausible candidate maternal immune mechanism (6). The present data from a high fertility population outside Euro-America similarly strengthen the status of the FBOE but downgrade the likelihood of an FFE, consistent with other findings across multiple samples (7, 10, 21). These findings encourage us to reconsider our previous conclusions and analyze confounded data more appropriately, as well as recalibrate evolutionary models pertaining to the development and evolution of male androphilia, ensuring our theories fit the data.

Ethics Approval

No novel data were collected for this study. Past data were collected with approval from the University of Lethbridge institutional human subjects research ethics committee, and Samoan Research Visas obtained from Samoan Immigration with the support of the Samoan *Fa'afafine* Association.

Data, Materials, and Software Availability. Anonymized data have been deposited in Open Science Framework (40) (https://osf.io/pmdeg/).

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